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Accidental Opioid Overdose Fatalities in Western Australia, 2008-2012: A Case for More Targeted Intervention

Natalie J. Castalanelli

A report submitted in Partial Fulfilment of the Requirements for the Award of Bachelor of Arts (Psychology) Honours, Faculty of Health, Engineering and Science,

Edith Cowan University.

Submitted October, 2015

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Accidental Opioid Overdose Fatalities in Western Australia, 2008-2012: A Case for More Targeted Intervention

Abstract

While there are current opioid overdose prevention strategies in Western Australia, these strategies are targeted at illicit opioid users and rely on bystander presence to intervene. The aim of the current study was to identify disparities between current overdose prevention strategies and the actual circumstances surrounding opioid related fatalities, to inform the development of best-practice opioid overdose prevention strategies for Western Australia. To do this, coronial files were drawn from the National Coronial Information System for accidental illicit opioid related fatalities (N = 329) and accidental prescription opioid related fatalities (N = 126) for the years 2008 to 2012. Each group was separately examined for prevalence of bystander presence at fatal opioid overdoses, the help seeking behaviours of those present, reasons for not intervening, and whether there were there any demographic variables associated with bystander presence. Additionally, the illicit opioid group was examined for geographical fatality clusters. The results showed that the majority of both illicit opioid and prescription opioid fatalities occurred where there was no bystander present to intervene. Where there was bystander presence and the overdose was recognised, emergency services were frequently engaged. However, many bystanders failed to recognise an overdose in time to intervene. These findings suggest that current WA interventions that rely on bystander presence to intervene will have limited value in preventing opioid overdose fatalities. More emphasis must be placed on addressing solitary opioid use, as well as efforts to equip likely bystanders with the skills to recognise and respond to opioid overdose.

Author: Ms. Natalie J. Castalanelli

Supervisors: Dr. Greg Dear and Dr. Susan Carruthers

Word count: 10 470

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Dated: 26 October 2015

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Accidental Opioid Overdose Fatalities in Western Australia, 2008-2012: A Case for More Targeted Intervention

Overdose (OD) deaths, which are chiefly related to the use of opioids, have exceeded traffic related fatalities in Australia becoming a major contributor to injurious deaths (Pennington Institute, 2015). The latest Australian report released by the National Drug and Alcohol Research Centre (NDARC), states that opioids were either singularly or concomitantly involved in 617 fatalities among those aged 15-54 years in 2011 (Roxburgh & Burns, 2015). Of those 671 deaths, 88 occurred in Western Australia (WA; Roxburgh & Burns, 2015).

Since the NDARC data collation began (Appendix A), opioid deaths in WA have increased almost fivefold, from 18 deaths in 1988 to 88 deaths in 2011, and have again risen to rates observed during the well documented heroin market expansion in the late 1990's (Roxburgh & Burns, 2015). In order to evaluate current opioid overdose prevention strategies and guide more targeted health promotion messages, it is essential that evidence on features of opioid related deaths in WA remains accurate and current.

The research reported in this thesis provides data to inform the development of best practice strategies to prevent opioid overdoses in WA, and evaluate current strategies. I examined coronial data of opioid related deaths that occurred in the state between 2008 and 2012. Those data were used to identify disparities between current overdose prevention strategies and the actual circumstances surrounding opioid related deaths in WA.

The thesis begins with a brief general description of opioids and how they act on the human body and brain, as well as physiological events that lead to opioid related overdose. This is followed by an account of what we already know about opioid related fatalities, predominantly at a national level. I then report on areas where there is emerging concern, but little current evidence. Following this, I summarise existing WA interventions, including the

naloxone hydrochloride (naloxone) program which trains opioid users on how to administer the short acting opioid antagonist to reverse overdose, and the Overdose Prevention Management (OPAM) program, followed by a summary of national and international opioid overdose intervention strategies. The present study's aim and research questions are then outlined, followed by a detailed outline of the research and discussion of the findings.

What are Opioids: Physiological Effects and Overdose

The opioid class of drugs encompasses natural opioid products (e.g., morphine and codeine) which are derived from the opium poppy plant, semi-synthetic opioids (e.g., heroin and oxycodone), and synthetic opioids (e.g., methadone and fentanyl) which are produced through a process of chemical synthesis (Jones, Mogali, & Comer, 2012). Opioids are severe pain relievers that exert their effect by binding to opioid receptors, principally located in the peripheral and central nervous system, and gastrointestinal tract (South Australia Health, 2012). They reduce the feelings of pain by interrupting the transmission of pain messages to the brain (Monthly Index of Medical Specialties, 2015). This class of drugs has multiple effects on human physiology including temperature regulation disturbance, depressed respiration, decreased gastrointestinal tract motility and decreased urinary output, as well as producing psychoactive effects of either euphoria or dysphoria (Jones et al., 2012).

Fatal opioid overdose occurs when the brain becomes oxygen deprived resulting from obstructed airways caused by inhalation of vomit due to reduced conscious state, or breath slowing to a rate where blood oxygen levels fall below that required to sustain vital organs (> 97%; United Nations Office on Drugs and Crime [UNODC], 2013). When oxygen saturation levels drop below 87%, the brain is adversely affected and can no longer function normally (UNODC, 2013). During this time an individual will become unresponsive, blood pressure will decrease, the heart rate will slow; eventually resulting in cardiac arrest (UNODC, 2013). Opioid overdose death can occur within a few minutes of injection/ ingestion, but more

commonly there is a period of unresponsiveness of up to several hours (UNODC, 2013). Research has shown that simple intervention during this crucial period is strongly associated with survival (Walley et al., 2013).

Opioid Overdose Fatalities: What We Already Know

A recent national report describes national opioid related fatality data in persons aged 15 to 54 years from 1988 to 2011 (Roxburgh & Burns, 2015). The WA specific frequency data from that study (see Figure 1) shows a bimodal trend in opioid related fatalities; first in the mid to late nineties and again beginning in 2008. The trough between those two peaks is commonly referred to as the 'the great Australian heroin drought' (Degenhardt, Day, Hall, & Bewley-Taylor, 2007).

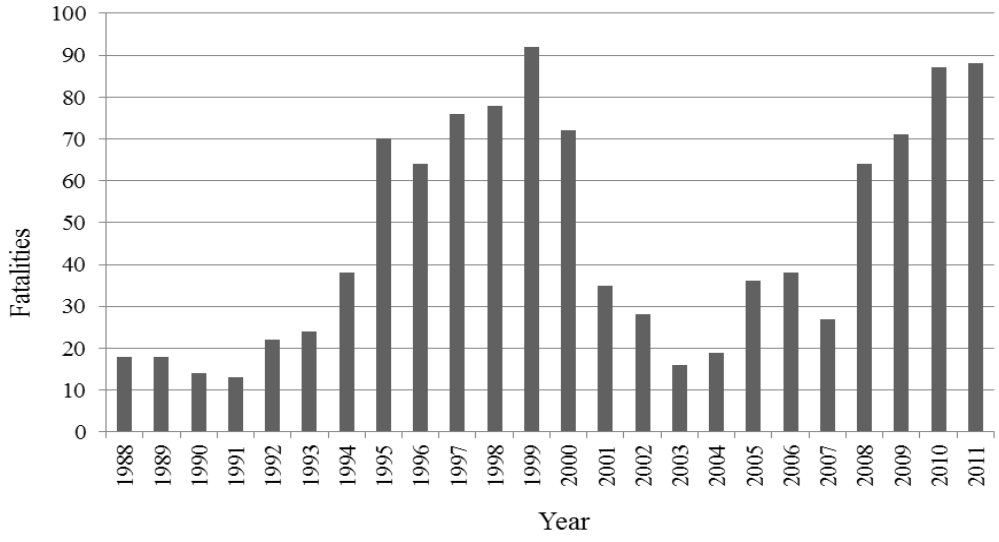

Figure 1. Total WA opioid related deaths among those aged 15-54, 1998-2011.

The Great Australian Heroin 'Drought'

Although there is still much contention about the cause; evidence suggests a major national heroin market expansion in the late 1990's, such that the drug became readily available at high purity levels and low cost (Dietze & Fitzgerald, 2002). The clearest indication of this growth was the steep rise of opioid related deaths (Appendix 1) observed nationally starting during the mid-1990's, and peaking in 1999 (Gibson et al., 2003). During

this time, corresponding market related data were gathered from all states and territories around Australia (Gibson et al., 2003). These data indicated that heroin was the drug of highest injecting prevalence in Australia, and that high purity, low cost heroin was readily available in the majority of Australian states and territories (Gibson et al., 2003)

There was an abrupt change in the availability of heroin in 2001 which affected most Australian jurisdictions simultaneously, including WA (Degenhardt et al., 2007). The reduction in heroin supply resulted in price increase, purity decrease, availability difficulties, as well as a dramatic (67%) drop in opioid related fatality numbers nationally (Degenhardt et al., 2007). During this purported heroin drought, opioid deaths merely returned to levels observed prior to the heroin market expansion; a strong indicator that the market simply returned to baseline from a surge (Degenhardt et al., 2007).

Current WA Trend

When considering the more recent WA fatality trend, there is a vast overrepresentation of WA fatalities, per million population, compared with other states from 2008 onwards. These data (Appendix B; Roxburgh & Burns, 2015) indicate that opioid fatality rates in WA are trending steeply, and independently, upwards at a rate that cannot be accounted for by population growth alone (Figure 2).

A possible explanation for this sharp increase in opioid related deaths from 2008 could be due to the purity of heroin available during this period in WA, relative to other states (Australian Crime Commission [ACC], 2014). Since the early 2000's, national heroin purity has remained at a relatively stable level of between 10-30%. However, analysis of WA heroin seizures during 2009-2010 heroin seizures in WA showed mean purity levels of 51%, with highest levels at 61% (ACC, 2014). Given the lag between what is available on the street and what is available for purity testing, there is a plausible link between heroin purity in WA and the fatality spike from 2008.

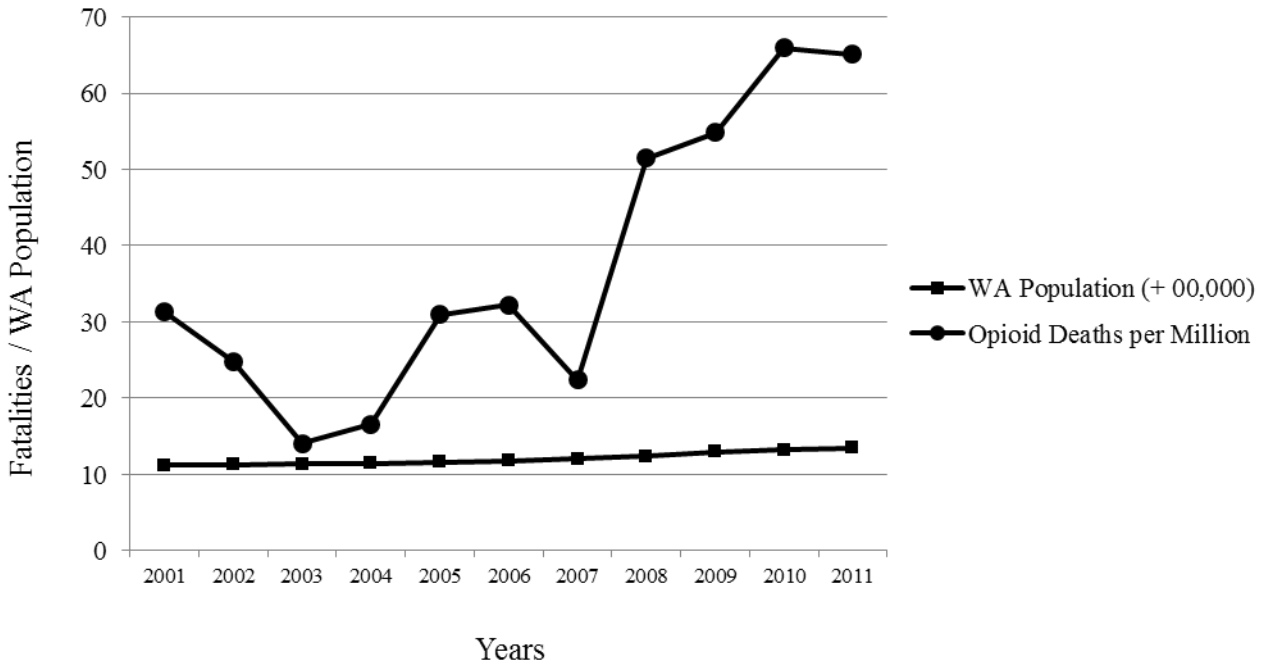

Figure 2. Number of accidental opioid overdose deaths in WA among 15-54 year olds per million population, against WA population growth for 15-54 year olds (+00,000), 2001 - 2011.

Demographic and Drug Trends

A national summary of what is known about all opioid related fatalities; 2007 through 2011 was compiled by the National Coronial Information System (NCIS; 2014). These data (*N* = 4102) show that just under two thirds (61.7%) opioid related fatalities occur in males, with the highest proportion (28.4%) observed in the 35-44 age group (NCIS, 2014). Heroin was cited as the opioid drug most frequently involved in death (27%), followed by methadone (21%), then oxycodone (19%). Polydrug use was present in almost three quarters (74.5%) of all national opioid related fatalities, with alcohol and benzodiazepines cited as the most frequently observed co-occurring non-opioid substances (NCIS, 2014).

National data shows a trend towards an older (over 40 years) population of opioid users, and a decrease in the number of opioid users in the younger (under 40 years) age categories (Australian Injecting and Illicit Drug Users League [AIVL], 2011). This is

reflected in mortality data, where the mortality rate in the 45-54 year category has shown a steady increase since 2001, while mortality rate in the 15-24 year category has remained low, and stable (Roxburgh & Burns, 2015). The steady increase in opioid related fatalities in the 45-54 year category may reflect the aging population of the post-World War II population expansion (baby boom), and the resultant larger population size of this age group relative to other time periods (AIVL, 2011). While these aggregate data are important and necessary, they tell us little about the circumstances surrounding opioid related fatalities.

Recovery from Dependence

We also know that opioid use does not necessarily result in lifelong dependence (Winick, 1962). Based on a theory initially proposed by Winick (1962), a significant proportion of people become dependent to substances due to time specific psychosocial pressures, and subsequently 'mature out' of dependence once these pressures abate. Winick suggested substance dependence to be a self-limiting process and, given time, a maturation process in the lifecycle of dependence often results in natural resolution of the dependence (Winick, 1962).

Additionally, for those where natural resolution does not occur, there are a range of formal treatment options available for opioid dependence including pharmacotherapy and behavioural treatment, with proven efficacy records (Marsch et al., 2005). Accordingly, a proportion of those with opioid dependencies will either naturally recover, or enter treatment programs to address their dependence, going on to lead fulfilling and accomplished lives (Marsch et al., 2005; Winick, 1962). Thus, every opioid related overdose that does not result in a fatality permits further opportunity towards meaningful recovery.

WA Opioid Fatalities: What We Need to Know

Bystander Presence and Intervention

There is little information on contextual circumstances surrounding opioid fatalities. However, there was a spate of Australian research conducted on fatal heroin overdose in the 1980s and 1990's, unanimously concluding that the majority (between 58% and 79%) of heroin fatalities occurred in the company of others (Drew, 1982; Walsh, 1991; Zador, Sunjic, & Darke, 1996). Similar findings were shown in a study which examined accidental fatalities among heroin users in South Australia between the years 1994 and 1997 (McGregor, Ali, Lokan, Christie, & Darke, 2002).

McGregor et al.'s (2002) study showed that within a total of 101 cases, only 28 cases (28%) were alone at death. Where there was a witness present, emergency assistance was sought in less than a fifth (19%) of cases (McGregor et al., 2002). Similar findings were observed in Zador et al.'s study (1996), where medical assistance was sought prior to death in only 15 of 88 cases (17%) where a bystander was present to intervene. Thus, although overdose was commonly witnessed, there was an overwhelming failure to seek assistance, with fear of police involvement cited as the most common reason, together with a high prevalence of bystander intoxication (80%) at overdose events (Darke, Ross, & Hall, 1996; McGregor et al., 2002)

Conversely, a study in the United States (US), which reviewed heroin related fatalities in San Francisco between the years of 1997 and 2000, revealed that under a third (32%) of fatalities occurred in the company of others (Davidson et al., 2003). Where there was bystander presence, an ambulance was called in 82% of cases. However, prior to paramedic arrival, first aid was only performed in 19% of these cases (Davidson et al., 2003). These dated, incongruent findings demonstrate the need for more contemporary data on bystander presence and intervention at fatal opioid overdose in WA.

Using Alone

While the Australian research shows that the majority of opioid overdose fatalities occur within witness presence, those opioid users who overdose while using alone are at particular risk of a fatal outcome (Baca & Grant, 2005). Based on consultation with a cohort of illicit opioid users, the Department of Health and Human Services (DHHS) in Victoria cite that where users chose to use alone, the top three reasons for solitary use were that they did not want to share and diminish a dose of drugs, concern over theft of drugs and other personal belongings, and the stigma of asking a non-user to be with them while using (DHHS, 2011).

Additionally, many illicit opioid users have cited fear of authorities, concealing use, or just wanting or needing to use when no one is present as reasons for using alone (Curtis & Guterman, 2009). Interestingly, when the users were made aware of the heightened risk of fatality linked with solitary opioid use, they indicated no intention to modify these behaviours; stating that, when necessary, they would continue to use alone (DHHS, 2011). Given this, it becomes important to identify the proportion of WA users who were alone at death, in order to evaluate the need for targeted intervention for those who use alone.

Illicit Opioid (IO) Users

Together with the well-established heroin market, the past decade has seen a sharp rise in diverted (use by someone other than the person it was prescribed to), and extra medical (using an opioid in a manner outside of its prescribed indications) opioid use (Nicholas, Lee, & Roche, 2011). IO's may be obtained through illegal sale of pharmaceutical medications, visiting numerous doctors to obtain multiple prescriptions (doctor shopping), theft, and medication swapping / sharing (Inciardi, Surratt, Cicero, & Beard, 2009). Between the years of 2007 and 2010, the number of Australians who used pharmaceuticals for non-medical purposes increased by more than 100,000, from 640,000 to 770,000 (Nicholas et al., 2011).

Nielsen et al. (2011) examined whether IO users had similar characteristics to heroin users (Nielsen et al., 2011). Demographic and substance use data were collected from users presenting to treatment facilities, and multivariate analyses were used to identify whether these two groups had distinct characteristics (Nielsen et al., 2011). Results showed very few distinct features, with both heroin and IO users showing similar demographic characteristics (male prevalence, early thirties, unemployed), high prevalence of injecting drug use, and interchangeable use of both heroin and illicit prescription opioids, depending on availability (Nielsen et al., 2011). However, although Nielsen et al. concluded that IO users and heroin users are largely homogenous, they also identified a distinct group of prescription opioid users who did not typically inject, and who commonly initiated opioid use for pain management (Nielsen et al., 2011).

Prescription Opioid (PO) Users

The prescription and use of PO medications has increased progressively over recent years, resulting in increased opioid related harm (Hallinan, Osborn, Cohen, Dobbin, & Wodak, 2011). This is of particular concern for those aged 45-54, where reports show a 50% increase in the incidence of opioid related deaths since 2008 (Roxburgh & Burns, 2012). Due to their age, these users are the most likely to receive opioid medication as part of a pain management program and will not necessarily receive the necessary harm reduction information, or appropriate intervention targeted to their specific needs (Roxburgh & Burns, 2012).

The specialist drug and alcohol treatment systems in Australia are typically designed to serve the needs of illicit drug users and alcohol consumers (Nicholas et al., 2011). Although opioid use is common among such groups, there are other populations that are not typically encountered through these services, including the growing population of individuals using prescribed opioid medication (Nicholas et al., 2011). Relative to IO use, there has been

little research into PO use, those who use PO's, and the harm associated with them. This calls for a better understanding of the circumstances surrounding PO fatalities to assess the need for targeted harm reduction strategies for this group of opioid users.

Interventions

Current WA Interventions

Opioid overdose fatalities are preventable (Lenton, Dietze, Degenhardt, Darke, & Butler, 2009). There are current overdose intervention strategies aimed at opioid users in WA, albeit in their infant stages. These interventions focus mainly on overdose response and naloxone education, which rely on certain behaviours and circumstances (e.g., not using alone) to be viable (Baca & Grant, 2005). These interventions are targeted to IDUs through user networks, outreach workers, needle and syringe exchange programs, and peer based organisations, and thus may have restricted reach to those choosing to access such services (Nicholas et al., 2011).

Peer administered naloxone training. The Western Australian Substance Users Association (WASUA) currently runs an overdose prevention training program which includes basic overdose first aid, as well as distribution of take home naloxone; an opioid antagonist which induces instant opioid withdrawal and reverses overdose (WASUA, n.d.-a). This intervention is based on the supposition that the majority of opioid overdose fatalities occur in the company of others, providing opportunity for bystander intervention, including first aid and naloxone administration (Kerr, Dietze, & Kelly, 2008).

WA naloxone training is open to the general public, and is strongly encouraged for peers and family members of opioid users; however naloxone can only be legally prescribed for personal use to participants who identify as past or current opioid consumers (WASUA, n.d.-a). Furthermore, under the current prescription model, naloxone prescriptions are provided with the intention that the drug only be administered to the individual to whom it

was prescribed (Lenton et al., 2015). The implications of these restrictions mean that this lifesaving medication may not be readily available for use in an opioid overdose emergency; and where it is, bystanders may be hesitant to use it for fear of negative legal ramifications (Lenton et al., 2015).

Despite no reportable data on the efficacy of the WA program at this time, anecdotal information shows positive initial harm reduction corollaries, as well as significant consumer accounts of personal and peer opioid overdose reversals (L. Jinks, personal communication, June 25, 2015). Additionally, a recent evaluation of the ACT program has reported training 200 participants between 2012 and 2013, with 57 successful overdose reversals using program-issued naloxone (Olsen, McDonald, Lenton, & Dietze, 2015).

Overdose Prevention and Management Program (OPAM). Additionally, WASUA runs a peer brief intervention model, OPAM, which was established in 2009 (WASUA, n.d.-b). This program is targeted to IDU's within the metropolitan district of Perth, and aims to recruit, train, and support a team of peer educators to disseminate opioid overdose harm reduction information to other users that they may encounter (WASUA, n.d.-b). The rationale behind this project is based on the premise that peers have privileged access to other IDUs that have little or no contact with alcohol and other drug (AOD) services (WASUA, n.d.-b).

Much of the information circulated through this network is focussed on harm reduction strategies, including first aid response in an overdose emergency (WASUA, n.d.-b). While these programs appear to be effectively reaching their target group, the number of opioid related fatalities in WA continues to rise. Thus, it seems that there is a disparity between the some of the suppositions on which these programs are based, and the actual circumstances surrounding such fatalities.

National and International Interventions

Sydney Medically Supervised Injecting Centre (MSIC). The MSIC in Kings Cross, Sydney is a facility staffed by nurses and counsellors and operates similarly to any other health service in Australia. These medically supervised facilities allow users to inject drugs under the supervision of medically trained professionals (Uniting Care, 2015). It must be noted, however, that these are distinct from the illegal 'shooting galleries' run for profit by drug suppliers, where illegal drugs may be obtained, prepared, and taken by injection, often with equipment provided by the premises. Kings Cross was considered the most appropriate site for the MSIC as it had the highest frequencies of overdose fatalities in New South Wales, and Australia (Uniting Care, 2015). Prior to the establishment of the MSIC, Kings Cross showed an average of four overdose fatalities per month, which reduced to an average of one per month, post establishment (Salmon, Kaldor, & Maher, 2007).

The aims of the centre are to improve the health and social welfare of clients, to reduce deaths from overdose, and to reduce injecting in public (Uniting Care, 2015). The Kings Cross MSIC has been rigorously evaluated, with twelve evaluation reports over fourteen years confirming that the facility is meeting its aims (Uniting Care, 2015). Accordingly, since its inception in 2001, the MSIC has managed over 5925 overdose events without a single fatality (Uniting Care, 2015).

Wearable naloxone auto-injectors. An innovative design proposed by Harvard School of Public Health sought to address the reliance on bystander response to effectively administer naloxone. The proposed design is a sensor enabled naloxone auto injector, worn on an opioid user's upper calf; optimal for both intramuscular injection and sensor placement

over a major artery (Gilbert, 2014). The sensor array uses photoplethysmography[1] to monitor the tibial artery as a measure of slowing respiratory rate; a primary indicator of opioid overdose (Gilbert, 2014).

Based on current standard practice for identifying potential opioid overdose, where respiration drops below a safe threshold, a sequence of elicitation responses are activated. The device initially vibrates, and then loudly prompts the wearer to press the deactivation button. Where there is no response after one minute, the auto injector is activated delivering the first dose of naloxone followed by audio instructions to deactivate the device and seek emergency care (Gilbert, 2014). Where there is still no response after a minute, a second dose of naloxone is administered, followed again by instructions to seek emergency care (Gilbert, 2014). If the deactivation button is pressed at any time during this sequence, the device resets and returns to monitoring phase (Gilbert, 2014). This novel device incorporates current WA opioid overdose reversal strategies, while addressing the need for bystander presence.

The Current Study

Where bystanders are present, willing, and able to intervene in an opioid overdose, fatalities should be a rare occurrence (Davidson et al., 2003). While there are current interventions in place to decrease opioid overdose fatalities in WA, the fact that these fatalities continue to increase suggests that one or more of these three factors (presence, willingness, ability) are absent. Thus, the social context of opioid related overdose becomes equally as crucial as the physiological context in understanding and preventing fatalities (Davidson et al., 2003).

The aim of this study is to identify disparities between current WA overdose prevention strategies and the actual circumstances surrounding opioid related death. Based on

[1] Photoplethysmography: A simple and low-cost photo technique that can be used to detect blood volume changes in the microvascular bed of tissue. It is often used non-invasively to take measurements of vital signs at the skin surface.

the previously discussed research that identified IO and PO users as separate groups in need of targeted intervention; these circumstances were considered separately for the two populations. Specifically, the research questions were:

1) What was the prevalence of bystander presence at fatal opioid overdoses?
2) What were the help seeking behaviours of those present?
3) What were the reasons for not intervening?
4) Were there any socio-demographic variables associated with bystander presence?

Additionally, in order to further assess the feasibility of previously discussed national interventions in the WA context, an exploratory research question was posed singularly for the IO group:

5) Were IO fatalities concentrated in discrete geographical areas of WA?

Method

I used a quantitative, exploratory-descriptive research design to describe opioid overdose deaths in WA. As these data already existed, I used an archival method to source, collate, analyse, and describe relevant variables. Ethics approvals to conduct this research were granted from Edith Cowan University, WA Coroner's Office, NCIS, and Department of Justice (Victoria).

Coronial Data

All data were extracted from coronial findings, which are formal documents prepared by a coroner following a rigorous and comprehensive inquest into a death. During an inquest hearing, a coroner considers evidence to determine the identity, place, date, manner, cause, and circumstances surrounding a death. Evidence is heard under cross examination from a range of sources, including police, witnesses, and toxicologists. Where it is not possible to make an unequivocal finding, a case is ruled as an 'open finding'; these cases were not

considered in the present study (Coroners Court of Victoria, 2013). Thus, the data in this study are grounded on legal facts.

Case selection

To identify opioid related deaths on the NCIS database, I searched via the *'Query Design'* function of all closed cases where the death occurred within the calendar years of 2008 through 2012. A proportion of cases within any given period will remain open on the NCIS; a case remains open until an investigation is complete, and a coronial finding is made. Thus, these years were chosen as they are sufficiently recent to be relevant, and contain between 97.1% and 99.9% of closed cases for WA. Case closure rates drop to 93% for 2013, and 63% for 2014, making a larger proportion of the population of interest unavailable for inclusion in this study.

I simultaneously searched coronial records by mechanism of injury (poisoning by pharmaceutical substances), and object of injury (pharmaceutical substance). Then, as guided by Jauncey, Taylor, and Degenhardt (2005; Appendix C), I confirmed cases using the International Classification of Diseases version 10 (ICD 10) codes: F10 – F19, X40 – X49, X60 – X69, X85, and Y10 – Y19. In addition to these codes, I included W78 (inhalation of gastric contents) into this study. Where there was no ICD 10 code assigned (four instances), suitability was confirmed by manual examination of the coronial finding.

Following this, I manually examined all cases for confirmation of opioid related fatality. Cases were retained in the dataset only where the coroner determined an opioid drug as either the primary cause of death, or a contributory cause of death in the case of multiple drug toxicity. This was determined where drug toxicity was noted in sections 1a to 1d of cause of death, or aspiration of gastric contents *and* drug toxicity was noted as cause of death. Thus, a case was included only where first aid intervention or naloxone administration could have theoretically altered the fatal outcome. My data are conservative as they do not include

open investigations, and fatality numbers will increase as additional cases are finalised and closed by the WA Coroner.

Cases in the sample. One hundred and four cases were excluded from the sample. Eighty-seven of these cases were ruled by the coroner as intentional self-harm (suicide), 16 were of undetermined intent, and one was the result of an assault. A total of 455 accidental opioid related deaths were identified in WA between 1 January 2008 and 31 December 2012. Fatalities for each calendar year were 72 in 2008, 95 in 2009, 90 in 2010, 97 in 2011, and 101 in 2012. These data are slightly higher than the fatality numbers reported by Roxburgh and Burns (2015) for corresponding years, as I reported on all age groups, whereas their data are limited to fatalities occurring in those aged 15-54 years.

User groupings. Through manual examination of the case files, I divided the sample into two groups based on the legality of the opioid use. The *'IO'* group (N =329) consisted of all fatalities where heroin was the primary opioid causing death, or where the primary opioid causing death was not prescribed to the user (i.e., diverted). Where the primary opioid had been prescribed, a case was coded into this category where there was clear evidence of extra medical use (e.g., injecting methadone syrup intended for oral use). IO users and heroin users were grouped together based on analogous findings to Nielsen et al.'s (2011) study that observed homogeneity of characteristics, and thus intervention requisites, in these two user groups.

The *'PO'* group (N = 126) included all cases where case information indicated that the opioid use was compliant with prescription. This was determined where the primary opioid drug was prescribed to the individual, where the route of administration was consistent with drug indication, and/or where there was reference to a pain inducing disease, or recent incident / surgical procedure resulting in the prescription of opioids for pain relief.

Measures

Coding technique. Explicitly stated field data, such as age and gender, were coded directly from the NCIS database into a spreadsheet. For the fields where data were not explicitly stated, coding parameters were decided and set out in a coding guide (Appendix D). To test consistency and inter-rater reliability, my supervisors and I conducted a pilot test of the codes by independently coding; then comparing ten case files. There was minor inconsistency on the variable of whether an individual was *'alone'* between losing consciousness and death. To address this, we opted for a conservative approach and added *'likely alone'* to the coding options, to cover these cases (please see *'alone at death'* for full description of this measure). I made all coding decisions according to information and statements drawn from case files, which represent conclusions drawn by the coroner.

Socio-demographic data. Data on gender, age, Indigenous identification, employment status, and marital status were extracted. For the *'gender'* variable, each case was coded as either 'm*ale'* or *'female'* as stated in the coronial record. The variable '*age'* was broken down into eight increments of ten years each; '*15- 24', '25 – 34', '35-44', '45-54', '55-64', '65-74', '75-84',* and *'85-94',* where each case was assigned a number between one and eight based on age at death. '*Indigenous identification'* was broken into two categories, *'Indigenous'* and *'non-Indigenous* and was coded according to the status assigned in the coronial file. The *'Indigenous'* category comprised three sub-codes; '*Aboriginal not Torres Strait Islander', 'Torres Strait Islander not Aboriginal',* and *'both Aboriginal and Torres Strait Islander'.* A case was coded as *'non-Indigenous'* where the coronial file stated that the deceased was neither of Aboriginal nor Torres Strait Islander origin.

For the *'employment status'* variable, each case was coded as either *'student', 'employed', 'unemployed', 'home duties', 'retired pensioner', 'disability pensioner', 'prisoner'* or *'other'* corresponding to the status assigned in each coronial record. For the

'marital status' variable, each case was coded as *'married'* where the coronial record stated that the deceased was married or in a de facto relationship at time of death, or *'unmarried'* where the coronial record stated that the deceased had never been married, was divorced, separated, or widowed at time of death.

Toxicological data. Coronial findings and toxicological reports were manually inspected for conclusions on the *'primary opioid'* involved in the death, as well as any *'other substances'* noted. Furthermore, a case was coded as a *'polydrug'* death where there was more than one substance (opioid and non-opioid) present in the toxicological screen, or a *'sole drug'* death where there was only one drug (opioid) present in on the toxicological screen.

Opioid types. For the purpose of analyses, each opioid was considered as a separate drug, including where both morphine and codeine were detected together in the absence of any other drug. Given the complex similarities of metabolic and toxicological profiles of morphine, codeine, and heroin, a morphine/codeine drug combination indicates likely heroin exposure (Konstantinova et al., 2012). However as heroin exposure was unproven; the morphine/codeine combination was considered independently. This was a rare occurrence in the sample (< 10). The opioid drugs, each coded with a number between one and 11, were '*heroin', 'methadone', 'oxycodone', 'morphine', 'codeine', 'tramadol', 'propoxyphene', 'fentanyl', 'buprenorphine', 'pethidine',* and *'other'* (cases where no specific opioid drug was specified).

Other substances. Where the coroner's report or toxicological findings stated that a substance/s in addition to any opioids had contributed a fatality, I coded these as *'other substances'* and allowed for up to four other substances which was the maximum found in any one case. These substances were coded in no specific order (due to incommensurability). The other substances present in these samples were '*alcohol', 'benzodiazepines',*

'methamphetamine', 'cocaine', 'cannabis', 'ketamine', 'naltrexone', 'ecstasy', 'gamma hydroxybutyrate (GHB)', 'antidepressants/ antipsychotics', and '*amphetamines'.*

Circumstantial data. Data were extracted for route of opioid administration, history of use, location of death, whether there was a bystander present between loss of consciousness and death, interventions prior to death, and reasons for not intervening where there was known bystander presence.

Route of opioid administration. Police reports, coronial findings, and autopsy reports were examined for evidence of whether the primary opioid was administered by *'injection', 'oral',* or *'other'* means. Where this was not explicitly stated, coding decisions were made based on circumstantial evidence. For example, a case was classified as *'injection'* on this variable where a police report described a used syringe near the deceased's body, and where a recent injection site was identified at autopsy. Examples of when a case was coded *'oral'* on this variable include where open blister packs of prescribed medication were present on a bedside table next to the deceased, and where there was evidence of the same prescribed residue in the gastric contents post mortem. *'Other'* incorporated the low frequency routes of absorption, inhalation, and smoking, and was based on coronial findings and police witness statements.

History of use. Where coronial files did not plainly state the deceased's *'history of use'*, these coding decisions were made based on statements drawn from coronial case files. An individual was coded as a *'frequent user'* where records showed evidence of regular use such as prescription history, history of overdose, treatment history, or where the person was known to witnesses and/or authorities as a frequent opioid user. An example of a case statement about an individual who was classified as a frequent user: "*The deceased was a regular user of heroin and often passed out after injecting himself when intoxicated by alcohol*".

An *'infrequent user'* was coded as such where coronial files showed evidence of primary dependence to a drug class other than opioids, or when the deceased was not known by family or friends to be a regular opioid user. An example case statement from a case coded as an infrequent user: "*According to family and friends, the deceased had taken heroin on three previous occasions this year*" (reported in a late year death). Where death occurred from first time opioid use, a user was coded as a *'novice user'*. An example case statement from a novice user: '*The deceased had not previously used heroin and she was injected, with her consent, by the male acquaintance'*. A case was coded as indeterminate where there was not enough evidence in the supporting documents to make a clear call on this variable.

Location of death. Information was gathered from police reports and coronial findings as to the location of death. An individual was coded as being at their *'own residence'* where they died, or were found in their own home (including a share home). Similarly, the code *'known persons residence'* was used where the individual died or was found at a family, friend, or acquaintance's residence. *'Other residential'* incorporated all other residential locations, for example where a person died at a dealers residence, or where a person died while at a party hosted by someone previously unknown to them. The code *'commercial area'* was used for shopping precincts, office precincts, and petrol stations. *'Transport area'* encompasses all carparks, footpaths, and public roads (including where the individual was found deceased in a car). '*Recreation area'* was used for public parks, public open spaces, and public cultural areas including where an individual was found in a toilet stall in one of these areas). *'Hostel, outreach, or drop in centre'* was used for outreach type locations, that were not considered to be the individual's primary residence, and *'hotel/ motel'* where the individual died or was found in such an establishment. Where an individual was conveyed to a hospital and subsequently died, this location was coded as *'medical service area'*. The code *'other'* was used for all other low frequency locations not otherwise classified.

Bystander presence. For this variable I measured whether there was a bystander physically present to intervene at any time after the deceased lost consciousness and before the time of death. Where not explicitly stated, this was determined based on circumstantial evidence, drawn from the official coronial finding. The code *'no bystander present'*, comprised three sub codes, *'alone', 'likely alone',* and *'isolated from help'*. A case was coded as *'alone'* where the deceased lived alone, and there was no evidence of a second party presence (e.g., locked doors, secure premises), *'likely alone'* where they were almost certainly alone, but there was insufficient evidence to make an unequivocal assignment to the *'alone'* category. For example, where an individual was found alone in an unlocked residence with no sign of second party activity; or where mobile phone activity showed text messages requesting company, but without evidence of attendance. Where there was someone present in the same premises, but not present to intervene, for example alone in a private bedroom within shared accommodation, alone in a locked public toilet stall, alone in a hotel room, or where a partner was asleep in another room, the case was coded as *'isolated from help'*.

The code *'bystander present'* was used where there was explicit evidence of somebody present at the time of death. Where not explicitly stated, this was determined through contextual evidence drawn from the coronial finding. For instance, where someone witnessed the deceased collapse, where there was an emergency call placed indicating lack of breathing and pulse, or where a partner has awoken to the deceased next to them in bed. A case was coded as *'indeterminate'* where there was insufficient evidence to make an unequivocal assignment to one of the categories defined above.

Intervention. I manually examined coronial files and police reports for evidence on whether any intervention was initiated prior to death, the type of intervention, and where a bystander was present and no intervention was initiated; the reasons why not.

Where an intervention was initiated, the *'type of intervention'* was coded as *'emergency services engaged'*, which was further sub-coded into *'ambulance only'* and *'ambulance and first aid'*. A case was coded as *'ambulance only'* where there was evidence of an emergency call, and ambulance officers attended the scene. A case was coded as *'ambulance and first aid'* where there was evidence of an emergency call and that first aid was commenced prior to death (e.g., where the police report stated that first aid was being performed when ambulance officers arrived at the scene). A case was coded as *'first aid only'* where witnesses reported initiating first aid prior to death. The *'tried to rouse'* code incorporated various types of physical attempts to rouse the deceased person such as pinching, shaking, slapping, and splashing with water. A case was coded as *'no intervention',* where there was no evidence of intervention, such as where the individual was found alone and already deceased, or where the bystander present no intervention prior to death was initiated.

Reason for no intervention. Where the coroner statement contained witness statements from bystanders present at any time after loss of consciousness and before time of death, the *'reason for no intervention'* was coded as *'OD not recognised'*, which comprised two sub codes, *'missed OD'* and *'thought individual was sleeping'*. In circumstances where there was someone available to intervene, but were not aware that the overdosing individual had consumed opioids the case was coded as '*missed OD'*. Where a witness statement within a police report stated that the person available to intervene was aware that the overdosed individual had consumed opioids, but had assumed that they were unarousable due to deep sleep, these cases were coded as *'thought individual was sleeping'*. Where parties present had consumed intoxicating substances themselves and were either unconscious or incapacitated, a case was coded as *'too intoxicated to intervene'*.

Geographical data. Postcodes for *'location of incident leading to death'* were coded directly from the NCIS database cases files into a spreadsheet. These data describe the geographical area of the drug taking incident that led to death (e.g., the postcode where an ambulance was called to, or the postcode where an individual was found deceased subsequent to drug use).

Sample Characteristics

IO User Group

There were 329 cases in the IO group. The age at death ranged from 15 to 65 (M = 36.85, SD = 9.66). The 25-34 age range showed the highest rate of fatalities, with 114 cases (34.7%), and males accounted for 265 cases (80.5%). Indigenous Australians (all were Aboriginal) represented 4.3% of cases which is not significantly different to WA population rates of 3.1% (ABS, 2011). This was determined using a chi-square test (with $\alpha = .05$), χ^2 (1, N = 2239499) = 1.428, p = .232. Additionally, the majority of the IO group were unemployed (47.7%) and unmarried (76.2%).

Most fatalities occurred in frequent users (68.1%), with injection as the most frequent route of administration (79.6%). Fatalities most frequently occurred at the individual's own (47.1%) or a known person's place of residence (17.9%). The most commonly recorded primary opioid implicated in death was heroin in 195 cases (59.3%), second was methadone in 41 cases (12.5%), and third was oxycodone in 29 cases (8.8%). Polydrug fatalities represented the vast majority of cases (93.6%); these fatalities were the result of both opioid and non-opioid substances. The most commonly detected substances in addition to opioids were benzodiazepines, present in 61% of cases, alcohol present in 39% of cases, and antidepressants/ antipsychotics present in 37% cases.

PO User Group

There were 126 cases in the PO group. The age at death ranged from 18 to 91 (M = 46.56, SD = 11.80). The 45-54 age range showed the highest rate of fatalities, with 39 cases (31%). There was a more even gender split in the PO group, with males accounting for 66 cases (52.4%). Indigenous Australians (all were Aboriginal) represented 4.8% of cases, again not significantly different to WA population rates of 3.1% (ABS, 2011). This was determined using a chi- square test (with $\alpha = .05$), χ^2 (1, N = 2239296) = 1.139, p = .286. Additionally, the majority of the PO group were unemployed (50.8%) and unmarried (61.9%).

Most fatalities occurred in frequent users and opioids were most frequently taken by oral administration (87.3%). Fatalities most frequently occurred at the individual's own (76.2%) or a friend or a known person's place of residence (6.3%). The most commonly occurring primary opioid was methadone detected in 39 cases (31%), second was oxycodone in 29 cases (23%), and third was codeine in 23 cases (18.3%). Polydrug fatalities represented the vast majority of cases (98.4%); these fatalities were the result of both opioid and non-opioid substances. The equally most commonly detected substances in addition to opioids were benzodiazepines and antidepressants/ antipsychotics, present in 79% of cases; followed by alcohol, present in 21% of cases.

Results

The frequency function in SPSS version 22 was used to provide descriptive data to answer research questions one to three for both the IO and PO user groups. Research question one was addressed by examining the frequency breakdown in each category under the *'bystander presence'* variable, question two was addressed by examining the frequency breakdown in each category under the *'intervention'* variable, and question three was addressed by examining the frequency breakdown in each category under the *'reason for no*

intervention' category (see Table 1 for full bystander presence, intervention, and reason for no intervention details).

Table 1

Bystander Presence, Intervention, and Reason for no Intervention by User Group

	IO Users	PO Users
	n (%)	*n* (%)
Bystander Presence	*n* = 329	*n* = 126
No bystander present		
Alone	87 (26.4)	39 (31)
Likely alone	6 (1.8)	0
Isolated from help	86 (26.1)	41 (32.5)
Bystander present	145 (44.1)	46 (36.5)
Indeterminate	5 (1.5)	0
Intervention*	*n* = 145	*n* = 46
No intervention	77 (53)	27 (58.7)
Emergency services engaged		
Ambulance only	14 (9.6)	5 (10.9)
Ambulance and first aid	49 (33.8)	13 (28.2)
First aid only	3 (2)	0
Attempt to rouse	2 (1.4)	1 (2.2)
Reason for no Intervention	*n* = 77	*n* = 27
Overdose not recognised		
Thought was sleeping heavily	44 (57.1)	20 (74)
Missed OD	12 (15.6)	7 (26)
Too intoxicated to intervene	21 (27.3)	0

Note. * Where deceased in company of bystander

Total Sample

The total sample consisted of 455 cases. A bystander was known to be present after the deceased lost consciousness and before the discovery of death in 191 of the 455 cases

(42%), with 5 cases (1.1%) indeterminate on this variable**.** In 259 cases (57%) there was nobody physically present who could intervene. Of these 259 cases, in 126 cases the deceased was alone during this period, likely alone in an additional six cases, and isolated from help in a further 127 cases.

There were efforts to intervene in 87 of the 191 cases (45.5%) where there was known bystander presence. Emergency services were engaged in 81 cases (42.4%; 62 cases with additional first aid), first aid only in 3 cases (1.6%) and attempts to rouse the individual were recorded in 3 cases (1.6%). No intervention was initiated in 104 cases (54.5%) where there was known bystander presence. In the 104 of 191 cases where there was known bystander presence and no intervention was given, the individual was thought to be sleeping heavily in 64 cases (61.5%), the OD was not identified in 19 cases (18.3%), and the bystander available was too intoxicated to intervene in 21 cases (20.2%).

Socio-demographics and Bystander Presence

To answer the fourth research question, Pearson chi-square tests (with $\alpha = .05$) were used to evaluate whether any socio-demographic features were associated with bystander presence. The chi-square tests were not statistically significant for gender, age, Indigenous status, employment status, and history of use.

However, the chi-square test was statistically significant for the IO group on marital status, χ^2 (4, N = 329) = 23.543, p = <.001. For married individuals there was no bystander presence in 39.7 % of cases; while for unmarried individuals, there was no bystander present in 59.4% of cases.

Similarly, the chi-square test was statistically significant for the PO group on marital status, χ^2 (2, N = 126) = 11.724, p = .003. For married individuals there was no bystander presence in 44.7 % of cases; while for unmarried individuals, there was no bystander presence in 74.4 % of cases.

Geographical IO Fatality Clusters

The heat map indicates high frequency areas in the Perth metropolitan area for opioid incidents that led to fatality for the years 2008 through 2012 (Figure 3). The areas showing the highest fatality frequencies were Fremantle (11 cases), Bassendean and surrounds (10 cases), Karrinyup and surrounds (9 cases), Hillarys and surrounds (9 cases), and Mirrabooka and surrounds (9 cases). In addition to these metropolitan areas, there was a high frequency observed in Bunbury and surrounds (10 cases).

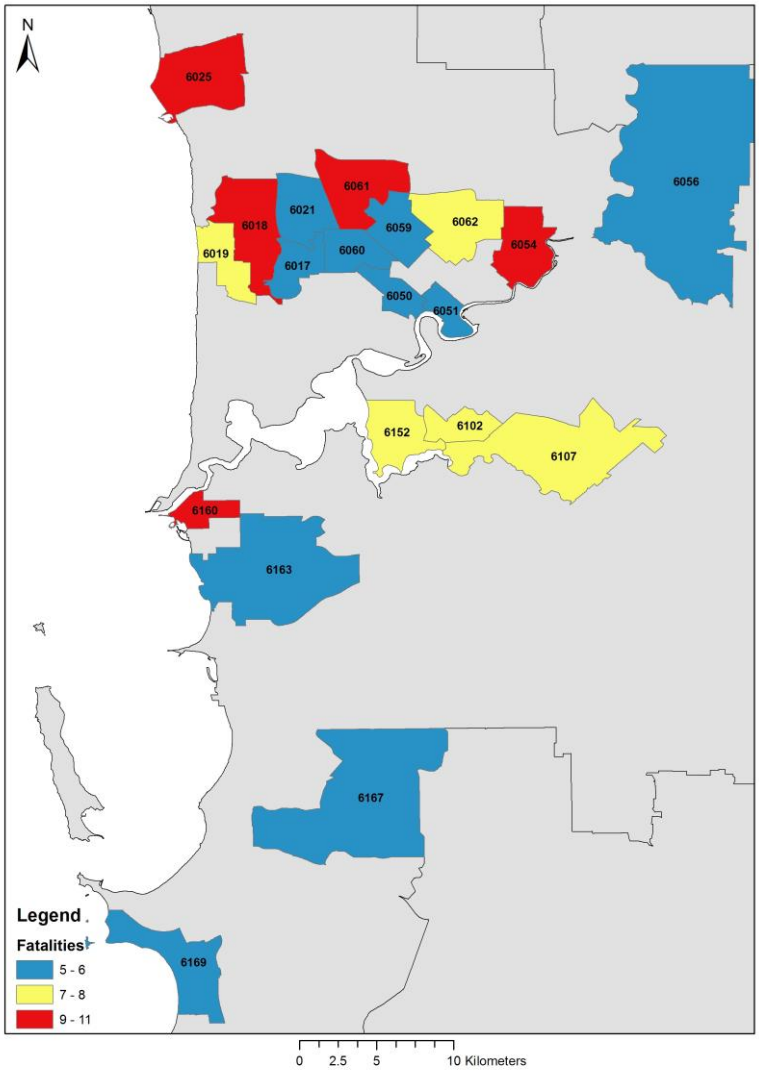

Figure 3. Map of Perth metropolitan area showing IO related fatality numbers by postcode for the years 2008-2012. Fatality numbers of < 5 are not represented on this map in order to protect confidentiality of the deceased.

Discussion

The findings of my study demonstrate that current WA interventions that rely on a bystander to intervene have limited value in preventing opioid overdose fatalities. In the combined samples (PO and IO user groups), there was no bystander present in 57% of cases, and the available bystander was too intoxicated to intervene in a further 5% of cases. Thus, no intervention strategies that rely on a second party could have prevented death in 62% of cases. An appropriate intervention (emergency service engagement) was initiated in a further 18% of total cases; however it is acknowledged that the administration of naloxone might have reversed overdose in some, perhaps many, of these cases. Thus hypothetically, at best 38% and, at worst, 20% of fatalities in my sample could have been prevented by intervention strategies that are currently implemented in WA.

Bystander Presence and Intervention

IO user group. Previous Australian research reported that the vast majority of fatalities occurred in company of others (Drew, 1982; McGregor et al., 2002; Walsh, 1991); yet low rates of help seeking interventions were initiated (McGregor et al., 2002; Zador et al., 1996). Thus, a major factor in those fatal IO overdoses was lack of intervention rather than lack of presence to intervene.

The results of my study suggest an evolved social context in IO use since those studies conducted in the 1980's and 1990's. Taken together, my results show a lower incidence of bystander presence available to intervene and higher incidence of emergency service engagement where bystanders were present. The higher incidence of emergency service engagement could reflect the protocol initiated in WA in the late 1990's, limiting police attendance at overdose events to protection of paramedics and scene control if no evidence of homicide or other serious felony exists (Hargreaves, Lenton, Phillips, & Swensen, 2002). Thus, the focus shifted from viewing an overdose as a criminal emergency,

to viewing it as a medical emergency (Hargreaves et al., 2002). This protocol was successfully disseminated to users via user networks, such as WASUA, and is now common knowledge amongst the IO user population in WA (L. Jinks, personal communication, June 25, 2015).

PO user group. In the absence of guiding research, one plausible reason for the high rate of unwitnessed fatality lies in the reason for PO use itself. Typically, those who are prescribed opioids are in a considerable amount of pain (Zacny et al., 2003). Those in severe pain, and medicated, will symptomatically spend large quantities of time incapacitated or sleeping, while those surrounding them attend to daily duties.

As was commonly noted in PO coronial case files (noted anecdotally in 19 cases), family and friends may become accustomed to their family member, or those under their care, sleeping deeply for substantial periods of time. This was evident in my data that showed that where there was bystander presence pre-death, the individual was thought to sleeping heavily in 74% of cases. Thus, it becomes important to engage family members and caregivers in the process and management of opioid treatment. However, it is acknowledged that the feasibility of this proposition must be further investigated for social and legal ramifications within the WA context.

Unrecognised Overdose

While many cases represented unwitnessed fatalities, there were a notable proportion of witnessed fatalities in both the IO and PO groups as well. Again contrary to previous research that cited fear of police as the main reason for not initiating emergency intervention (McGregor et al., 2002); where at least one bystander was present, the main reason in my study for bystanders not initiating intervention measures in both IO and PO user groups was that the overdose was not recognised. As such, current interventions must reinforce

information on how to recognise an overdose, and at what point an opioid affected person transitions from sleep or heavy intoxication, to being unconscious.

Where an opioid affected person is unarousable, they should not be assumed to be sleeping, particularly where there is loud guttural snoring present; a factor anecdotally noted in 85 cases in my study. In these cases, witnesses to an OD should be encouraged to engage emergency services as a first resort, followed by first aid. Additionally, as a last resort where fear of authorities prevents help seeking, bystanders could be encouraged to engage emergency services, place the overdosed individual in the first aid recovery position, leave doors unlocked, and leave the premises. Further investigation into the barriers to recognising opioid overdose and how to address these barriers is warranted.

Bystander Intoxication

Almost a third of bystanders to an IO fatality were not in a position to intervene due to their own level of intoxication; a circumstance which was singular to this group. The reason for this finding is likely to be that those who are present at IO overdose events have used the same or similar substances to the individual who overdosed. This explanation concurs with the findings made by Darke et al. (1996), which showed that over three quarters of those present at their last witnessed overdose were intoxicated themselves.

Bystander intoxication in these cases could have obstructed or delayed intervention initiatives in a number of ways. Those present might have lost consciousness due to heavy intoxication, rendering them physically unable to recognise the overdose and appropriately intervene. Additionally, where conscious, heavy intoxication may have impeded cognitive ability to acknowledge and react to the crisis situation. Further research into possible harm reduction strategies related to bystander intoxication at opioid overdose events is warranted.

Socio-demographics Associated with Bystander Presence

Both the IO and PO groups had a higher bystander prevalence at overdoses for those who were married or in de facto partnerships than those not in a relationship. This finding makes intuitive sense. Those involved in intimate partnerships typically share living space, as well as other daily activities and events in a more connected manner than those who share accommodation under other circumstances. As such, it follows that due to differing social conditions, opioid users who are intimately partnered are more likely than those who those are unmarried, divorced, or widowed to have bystander presence at an overdose event.

All of the other socio-demographic variables that I examined (gender, age, Indigenous status, employment status, and history of use) did not show any significant association with frequency of bystander presence in either the IO or PO group. In light of these findings, I propose that the social factors for using alone identified by DHHS (2011; sharing, theft, stigma) are likely to be greater factors associated with bystander presence than the socio-demographic variables examined in my study.

Geographical 'Clusters'

While my data shows some geographical clustering of opioid related fatalities, these results should be interpreted with caution. The areas showing high fatality frequencies (Figure 3) were widely geographically spread. Additionally, these high frequency areas were classified as such with as few as nine fatalities spanning over five years. Compared to overdose fatality frequencies supporting the location of the MSIC in Kings Cross (four per month; Salmon et al., 2007), the fatality figures in my study are relatively low.

While the Kings Cross MSIC is widely supported by users, community, and political stakeholders, it is still currently the only of its kind in the southern hemisphere (Uniting Care, 2015). This is perhaps a reflection of the unique need of such an establishment in this precinct, based on a highly concentrated street based injecting culture and concentrated

prevalence of overdose fatalities (Salmon et al., 2007); a context not supported for WA by my data. With relatively low frequency, widespread 'clusters', and overdoses occurring mainly in private residences rather than public spaces, there does not seem to be a particular geographical site that will profoundly impact on overdose fatality rates in WA.

Limitations

It would be remiss not to acknowledge that, due to the stigma and legal implications of opioid use in Australia, witnesses may have modified their accounts or departed the scene without detection. Thus, my data describing the frequency of bystander presence at a fatal overdose may marginally underreport the presence of others and attempts to intervene. Secondly, although cases were only included in the sample where an opioid was a primary contributor; there could be a small number of cases where the other substances that were concomitantly present were at a combined level to cause death. Thus, opioid intervention strategies might not have been effective in these cases. Lastly, a small proportion of PO users in this sample were close to the end of life and taking opioids as a measure of palliative care. As such, prolonging life might not have been the objective of the individual, or the kin of the individual, who overdosed.

Implications for Intervention Planning

The findings of my study demonstrate that more emphasis needs to be placed on encouraging opioid use in company of someone who is able to intervene. Additionally, given what is known about the previously summarised reasons and intentions surrounding solitary use (DHHS, 2011), opioid overdose fatality prevention must focus on strategies appropriate for users who continue to use alone. Education strategies that address the risks of solitary IO use would appear to be justified. However, the physiological effects of dependence may surpass ability, or desire, to practice risk reducing behaviours. Therefore, while communicating these risks is important, behavioural adaption strategies may have limited

utility within this population and a more pragmatic approach must include harm reduction initiatives for those who continue solitary use.

Furthermore, with my data showing a strong presence of PO users, it is critical that interventions for fatality prevention include those dependent on prescription opioids. Although comparable to the IO user group in most circumstantial characteristics, it would not be wise to rely on the current, or proposed, opioid overdose prevention strategies to engage this group of users. This group is likely to have developed dependence through different trajectories and require different strategies for engagement, intervention, and retention (Roxburgh & Burns, 2015). In proposing interventions, it becomes evident that while some of the interventions themselves may be similar for both IO and PO users, the context and delivery must be customised.

Intervention Strategies for IO Users

Educational resources. While there are current educational interventions aimed at IO users in WA (WASUA, n.d.-b), my results indicate that these do not seem to be effectively addressing those who choose, or are circumstantially bound, to use while they are alone. Together with general overdose reduction messages on the danger of poly-substance use, suggested strategies include personal assessment of whether there may be any reason for reduced tolerance[2] and if so, to consider using a smaller dose on that occasion (Curtis & Guterman, 2009). Injecting or snorting a small amount of the IO in order to gauge the strength before dosing fully as required (Curtis & Guterman, 2009). Using a regular supplier who is able to provide information on product strength, product changes, and other users experiences with the product may help solitary users to make informed decisions accordingly (Curtis & Guterman, 2009).

[2] Opioid tolerance occurs when the opioid receptors in the brain adjust to opioid action, thus requiring a higher dose of the drug to achieve the same level of response achieved initially.

Wearable naloxone auto-injectors. Existing naloxone practices in WA require bystander presence, which my study exposes as a significant limitation to fatality prevention. Given the number of unwitnessed, overlooked, and unattended overdoses in my study, a device such as the wearable naloxone auto injector (Gilbert, 2014) may have considerable utility in fatal overdose prevention in WA. Further studies that assess current users' attitudes and perceived utility of such a device are recommended. Additionally, cost analyses and feasibility studies are recommended to assess practicability within a WA context.

Intervention Strategies for PO Users

The current delivery of opioid overdose education and naloxone distribution through illicit substance user associations (WASUA) might be incompatible with, or undesirable to, individuals and caregivers of those prescribed opioids for pain management. In these cases, education on how to recognise opioid overdose, how to respond, the importance of conducting regular welfare checks, and naloxone distribution may be better received in a primary care setting.

Accordingly, Mueller, Walley, Calcaterra, Glanz, and Binswanger (2015) conducted a review on the implications for translating community based opioid overdose prevention and naloxone distribution into clinical practice. They posit that opioid prescribers bear a responsibility to assess risk and educate patients on the potential adverse effects of opioid use, including overdose (Mueller et al., 2015). Primary care practitioners are in the ideal position to apply their assessment expertise to identify patients as candidates for overdose education and naloxone training, based on their knowledge of risk factors for overdose (Mueller et al., 2015).

Counselling elements could include advice against taking higher or more frequent doses than prescribed, self-monitoring for changes in level of physiological and psychological function while on opioids, and educating friends and caregivers on the risks of

opioid overdose and actions to take in the event that an overdose does occur (Mueller et al., 2015). Where patients have been assessed as having an overdose risk, practitioners should prepare patients with a care plan to share with family and caregivers; outlining instructions to follow in the event of an overdose (Mueller et al., 2015).

Take home naloxone, and naloxone auto injectors, could form part of this preparation. However, Mueller et al. (2015) caution that this should not be a discrete event for this population, rather forming part of an ongoing education, monitoring, and dose adjustment regime. As naloxone cannot be self-administered in an overdose event, it is crucial to involve likely bystanders such as family and caregivers in overdose education and management training (Mueller et al., 2015). However, a number of barriers to prescribing naloxone were identified, including medical practitioner concerns over layperson injecting practice, legal implications, and concern for riskier drug use patterns (Mueller et al., 2015). These barriers need to be more fully understood before opioid overdose education and naloxone distribution programs can be initiated into primary care settings.

A report compiled by a team of medical doctors, pain specialists, and clinical researcher in the US further urged that clinicians provide brief intervention on the dangers of mixing unauthorised substances, including alcohol, with their opioid medication (Webster et al., 2011). Moreover, given that benzodiazepines, anti-depressants, and anti-psychotic medications are commonly implicated in opioid fatalities (my study showing separate prevalence in 79% of PO cases), Webster et al. (2011) caution clinicians to be cognisant, and to make patients cognisant, of potentiation risks (the effect of one drug greatly increased by the intake of another drug) when prescribing these substances concurrently with opioids (Webster et al., 2011).

As harms relating to PO use increase, developing strategies to engage non IO populations into opioid overdose prevention education and reversal training becomes

increasingly important. As such, I propose further enquiry into practical implications for, and barriers to, translating current community based opioid overdose prevention and naloxone distribution into clinical practice within the WA context.

Summary

The results of this study provide important insights into the circumstances surrounding opioid related fatalities in WA. In contrast to earlier Australian studies, the majority of opioid overdose fatalities between 2008 and 2012 in WA went unwitnessed; and where witnessed, were often not recognised as an overdose in progress. Additionally, there were no strong geographical patterns of IO fatalities observed; indicting that geographically placed harm reduction measures, such as safe injecting facilities, would not profoundly reduce opioid related fatalities in a WA context.

These findings have several implications for both intervention planning and further research, particularly in relation to deficits in current interventions targeting solitary opioid users, as well as undetected, and untreated overdoses. There is a clear need for more practicable harm reduction measures in WA that focus on those who use opioids while alone or isolated from help, those who are in company but overdose goes unrecognised, as well as caregivers of those on an opioid treatment regimen.

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Appendix A

Accidental Opioid Fatality Numbers in Australia

Table A1

Number of Accidental Deaths due to Opioids among Those Aged 15-54 by Jurisdiction, 1988-2011

Year	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	AUS
1988	204	99	16	12	18	0	0	2	351
1989	158	99	19	8	18	1	2	2	307
1990	196	79	8	19	14	5	0	0	321
1991	146	64	9	13	13	3	0	2	250
1992	182	79	18	30	22	0	1	4	336
1993	188	86	23	41	24	5	2	5	374
1994	209	97	37	32	38	4	5	3	425
1995	273	140	42	38	70	6	0	13	582
1996	260	145	32	32	64	5	2	17	557
1997	333	203	36	52	76	2	2	9	713
1998	452	243	64	53	78	10	13	14	927
1999	481	376	79	64	92	5	8	11	1116
2000	349	323	124	50	72	8	2	10	938
2001	177	73	58	18	35	8	5	12	386
2002	158	93	40	21	28	9	6	8	364#
2003	143	129	32	14	16	4	2	17	357
2004	144	126	34	25	19	6	1	2	357
2005	133	104	42	37	36	14	np*	np*	374
2006	138	118	42	20	38	15	np*	np*	381
2007	115	103	52	34	27	15	np*	np*	360
2008	137	170	62	43	64	11	np*	np*	500
2009	174	143	103	47	71	10	np*	np*	563
2010	150	169	142	41	87	9	np*	np*	613
2011	176	175	134	24	88	7	np*	np*	617

* np means that the data in these jurisdictions were not published in order to protect confidentiality.
# One death did not have a jurisdiction noted

Note. Reprinted from "Accidental drug-induced deaths due to opioids in Australia, 2011," by A. Roxburgh and L. Burns, 2015, *NDARC Publication,* p. 5. Copyright 2015 by National Drug and Alcohol Research Centre.

Appendix B

Accidental Opioid Fatality Numbers in Australia (per Million)

Table B1

Number of Accidental Opioid Deaths per Million Persons among 15-54 Year Olds in Australia by Jurisdiction, 1988-2011

Year	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	AUST
1988	62.5	39.9	10.1	14.9	19.7	0	0	11.4	36.6
1989	47.5	39.3	11.6	9.8	19.2	6.4	19.2	11.4	31.4
1990	58.2	30.8	4.7	23.1	14.6	19.1	0	0	32.3
1991	42.8	24.7	5.2	15.7	13.4	11.4	0	10.8	24.8
1992	52.9	30.3	10.1	35.9	22.4	0	9.2	21.1	32.9
1993	54.3	33	12.6	48.9	24.1	18.8	18.3	25.9	36.3
1994	59.9	37.1	19.7	38.1	37.7	15	45.5	15.4	40.9
1995	76.9	53.4	21.8	45.1	68.1	22.5	0	66.2	55.3
1996	72.7	54.8	16.2	37.9	61.2	18.7	17.7	85.6	52.2
1997	92.2	76.1	18.1	61.8	71.3	7.5	16.5	45.8	66.3
1998	124.1	90.4	31.7	62.7	72.1	37.8	106.1	71.3	85.4
1999	130.9	138.8	38.7	75.5	84.1	19	64.4	55.9	101.9
2000	94.1	118.1	60.1	58.9	65.2	30.6	15.9	50.5	84.9
2001	47.2	26.4	27.8	21.2	31.3	30.8	39.6	60.2	34.6
2002	41.9	33.2	18.8	24.7	24.8	34.9	47.8	40.1	32.3
2003	37.8	45.9	14.7	16.5	14.1	15.4	15.9	85.3	31.5
2004	38	44.6	15.4	29.5	16.6	23	8	10.1	31.3
2005	35	36.5	18.7	43.7	31	53.7	np*	np*	32.5
2006	36.1	41	18.3	23.5	32.2	57.4	np*	np*	32.8
2007	29.8	34.8	22.1	39.2	22.4	57.2	np*	np*	30.4
2008	35.1	56.5	25.7	49.2	51.5	42	np*	np*	41.5
2009	44.2	49.7	42	53.4	54.8	37.7	np*	np*	45.9
2010	37.8	54.5	57.2	46.3	65.9	33.8	np*	np*	49.5
2011	44.3	56	53.6	27.1	65.1	26.3	np*	np*	49.5

* np means that the data in these jurisdictions were not published in order to protect confidentiality.

Note. Reprinted from "Accidental drug-induced deaths due to opioids in Australia, 2011," by A. Roxburgh and L. Burns, 2015, *NDARC Publication,* p. 6. Copyright 2015 by National Drug and Alcohol Research Centre.

Appendix C

ICD 10 Codes

Table C1

ICD 10 Codes used in Case Selection Search

ICD-10 codes	Description
F10 – F19	Mental and behavioural disorders due to psychoactive substance use
F11	Mental and behavioural disorder due to use of opioids
F19	Mental and behavioural disorder due to multiple drug use and use of other psychoactive substances
X40 – X49	Accidental poisoning by and exposure to noxious substances
X42	Accidental poisoning by and exposure to narcotics and psychodysleptics, including cannabis, cocaine, codeine, heroin, SD, mescaline, methadone, morphine and opium
X44	Accidental poisoning by and exposure to other and unspecified drugs, medicaments and biological substances
X60 – X69	Intentional self-poisoning by and exposure to drugs, medicaments and other substances
X62	Intentional self-poisoning by and exposure to narcotics and psychodysleptics, including cannabis, cocaine, codeine, heroin, LSD, mescaline, methadone, morphine and opium
X85	Assault by drugs, medicaments and biological substances
Y10 – Y19	Poisoning of undetermined intent by drugs, medicaments and other substances
Y12	Poisoning by and exposure to narcotics and psychodysleptics, not elsewhere classified, undetermined intent, including cannabis, cocaine, codeine, heroin, LSD, mescaline, methadone, morphine and opium
Opioid-specific poison codes	
T40.0	Opium
T40.1	Heroin
T40.2	Other opioids
T40.3	Methadone
T40.4	Other synthetic narcotics
T40.6	Other and unspecified narcotics

Note. Adapted from "The definition of opioid-related deaths in Australia: implications for surveillance and policy" by M.E. Jauncey, L.K. Taylor, and L.J Degenhardt, 2005. *Drug and Alcohol Revie*w, p.402. Copyright 2005 by Australian Professional Society on Alcohol and Other Drugs.

Appendix D

Coding Guide

<table>
<tr>
<td>Socio- demographic Data
Gender:
Male (1)
Female (2)</td>
<td>Polydrug:
Yes (1)
No (2)</td>
</tr>
<tr>
<td>Age:
15-24 (1) 55-64 (5)
25-34 (2) 65-74 (6)
35-44 (3) 75-84 (7)
45-54 (4) 85-94 (8)</td>
<td>Circumstantial Data
Route of administration:
Injection (1)
Oral (2)
Other (3)</td>
</tr>
<tr>
<td>Indigenous identification:
Indigenous
Aboriginal (1)
Torres Strait Islander (2)
Both Aboriginal and TSI (3)
Neither Aboriginal nor TSI (4)</td>
<td>History of use:
Frequent (1)
Infrequent (2)
Novice (3)</td>
</tr>
<tr>
<td>Employment status:
Student (1)
Employed (2)
Unemployed (3)
Home duties (4)
Retired pensioner (5)
Disability pensioner (6)
Prisoner (7)
Other (8)</td>
<td>Location of death:
Own residence (1)
Know persons residence (2)
Other residential (3)
Commercial area (4)
Transport area (5)
Recreation area (6)
Hostel, outreach or drop in centre (7)
Hotel/ motel (8)
Medical service area (9)
Other (10)</td>
</tr>
<tr>
<td>Marital status:
Married (1)
Unmarried (2)</td>
<td>Bystander presence:
No bystander present
Alone (1)
Likely alone (2)
Isolated from help (3)
Bystander present (4)
Indeterminate (5)</td>
</tr>
<tr>
<td>Toxicological Data
Opioid type:
Heroin (1)
Methadone (2)
Oxycodone (3)
Morphine (4)
Codeine (5)
Tramadol (6)
Propoxyphene (7)
Fentanyl (8)
Buprenorphine (9)
Pethidine (10)
Other (11)</td>
<td>Type of intervention:
Ambulance called (1)
Ambulance called and first aid (2)
First aid only (3)
Tried to rouse (4)
No intervention (5)</td>
</tr>
</table>

Other substance:	*Reason for not intervening:*
Alcohol (1)	OD not recognised
Benzodiazepines (2)	Missed OD (1)
Methamphetamine (3)	Thought individual was sleeping (2)
Cocaine (4)	Too intoxicated to intervene (3)
Ketamine (5)	
Naltrexone (6)	
Ecstasy (7)	
Gamma hydroxybutyrate (8)	
Antidepressant/ antipsychotic (9)	
Amphetamines (10)	